

## **PENTOMINO PUZZLE GAME**

### **BENEFIT CLAIM**

This application is a continuation of International Application No. PCT/NL02/00498, filed  
5 23 July 2002, which has priority to NL 1018666 filed 31 July 2001.

### **FIELD OF THE INVENTION**

The present invention relates to a puzzle piece, designed to be positioned with respect to a border having a predetermined shape with a defined upper side and under side. The present invention further relates to a puzzle game, comprising a plurality of puzzle pieces.

### **BACKGROUND OF THE INVENTION**

10 US 3 964 749 discloses a puzzle game which comprises a holder having a rectangular recess and eighteen puzzle pieces, wherein the puzzle pieces are shaped as so-called “pentominoes”, which are defined as puzzle pieces which are theoretically constituted by five identical square elements, each square element having a full edge connection with at least one  
15 other square element. A player is supposed to fit all eighteen puzzle pieces in the recess, a receiving surface of which equals the surface of the eighteen puzzle pieces. Therefore, when the puzzle is completed, the entire receiving surface is covered by the puzzle pieces, wherein there is no space between the puzzle pieces. An interesting aspect of the puzzle game is the fact that there are many different ways in which the recess may be filled with the puzzle pieces. It is a  
20 challenge to many players to look for all possible solutions.

### **SUMMARY OF THE INVENTION**

According to the present invention, the puzzle piece is provided with marks. The marks offer the possibility of easy recording of the exact configuration of a plurality of puzzle pieces with respect to a border, as each puzzle piece may be provided with unique marks and as each  
25 possible orientation of the puzzle pieces with respect to the border may be represented by the marks. In other words, the marks may represent a certain puzzle piece as well as the orientation of that certain puzzle piece. Therefore, all that a player needs to do to record a configuration, is to view the border in its upright orientation and record the marks which have an upright orientation, in a predetermined sequence, for example a sequence which can be found when  
30 reading from left to right and from top to bottom.

It is an object of the present invention to provide a puzzle piece which offers the possibility of easy identifying said puzzle piece as well as its orientation in a puzzle. This object is achieved in a puzzle piece according to Claim 1. This object is also achieved in a puzzle piece according to Claim 8.

5 In a similar sense, it is an object of the present invention to provide a puzzle game which offers the possibility of easy recording of the configuration of the puzzle pieces in a border having a predetermined shape. This object is achieved in a set of puzzle pieces according to Claim 6. This object is also achieved in a puzzle game according to Claim 17.

10 It is noted that in this context, the concept of "orientation" relates to a position of a puzzle piece with respect to a border having a predetermined shape, in a plane parallel to main surfaces of the puzzle piece, which normally has a substantially flat shape, and applies to a front main surface as well as a rear main surface of the puzzle piece.

### BRIEF DESCRIPTION OF THE DRAWINGS

15 The invention will now be explained in greater detail with reference to the non-restricting examples of embodiments shown in the figures, in which similar parts are indicated with the same reference signs, and in which:

**Figure 1** is a plan view of a holder of a puzzle game according to the present invention;

**Figure 2** is a sectional view taken on the line A-A of **Figure 1**;

20 **Figure 3** is a plan view of the holder as shown in **Figure 1**, filled up with puzzle pieces according to the present invention;

**Figure 4** is a plan view of a front surface and a rear surface of a first puzzle piece according to the present invention;

**Figure 5** is a plan view of a front surface and a rear surface of a second puzzle piece according to the present invention;

25 **Figure 6** is a plan view of a front surface and a rear surface of a third puzzle piece according to the present invention;

**Figure 7** is a plan view of a front surface and a rear surface of a fourth puzzle piece according to the present invention;

30 **Figure 8** is a plan view of a front surface and a rear surface of a fifth puzzle piece according to the present invention;

**Figure 9** is a plan view of a front surface and a rear surface of a sixth puzzle piece according to the present invention;

**Figure 10** is a plan view of a front surface and a rear surface of a seventh puzzle piece according to the present invention;

5        **Figure 11** is a plan view of a front surface and a rear surface of an eighth puzzle piece according to the present invention;

**Figure 12** is a plan view of a front surface and a rear surface of a ninth puzzle piece according to the present invention;

10       **Figure 13** is a plan view of a front surface and a rear surface of a tenth puzzle piece according to the present invention;

**Figure 14** is a plan view of a front surface and a rear surface of an eleventh puzzle piece according to the present invention;

**Figure 15** is a plan view of a front surface and a rear surface of a twelfth puzzle piece according to the present invention; and

15       **Figure 16** is a plan view of a front surface and a rear surface of a puzzle piece according to the present invention being provided with alternative marks.

#### **DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT**

**Figures 1 and 2** show a holder **20** for receiving and holding puzzle pieces of a puzzle game according to the invention.

20       In the shown example, the holder **20** has a substantially flat shape. A rear surface **21** of the holder **20** is substantially flat, whereas a front surface **22** is provided with a recess **23** having a rectangular circumference **24**. The recess **23** comprises a supporting surface **25** for supporting the puzzle pieces.

25       Preferably, the holder **20** is made of a plastic. The recess **23** may be applied by means of a milling process.

Suitable dimensions of the holder **20** and the recess **23** are as follows:

- length of the holder **20**        : 180.0 mm
- width of the holder **20**        : 120.0 mm
- depth of the holder **20**        : 6.0 mm
- 30       - length of the recess **23**       : 150.5 mm

- width of the recess **23** : 90.5 mm
- depth of the recess **23** : 4.0 mm

**Figure 3** shows an entire puzzle game according to the present invention, comprising the holder **20** and twelve different puzzle pieces **30**. The shown puzzle pieces **30** are so-called pentomino pieces, which are defined as puzzle pieces which are theoretically constituted by five identical square elements, each square element having a full edge connection with at least one other square element. All possibilities for the shape of pentomino pieces are represented by the twelve puzzle pieces **30**, wherein in six pentomino pieces two possibilities are united, as the shape of their front surface is different from the shape of their rear surface.

In **Figure 3**, the twelve puzzle pieces **30** are shown in a state in which they fill up the recess **23** of the holder **20**, wherein the puzzle pieces **30** form a completed puzzle having a rectangular outer circumference. This outer circumference corresponds to the circumference of the recess **23**. In the completed puzzle, no space is present between the puzzle pieces **30**, and the puzzle pieces **30** cover the entire supporting surface **25** of the recess **23**.

It is a challenge to a player to find different ways for filling up the recess **23**. Some players may even try to find all possible configurations of the puzzle pieces **30**, knowing that the total number of different configurations is 9,356. The present invention offers the possibility of recording the found solutions in a convenient way. For this purpose, the puzzle pieces **30** are provided with marks **31**.

In the shown example, each puzzle piece **30** is on both sides, i.e. on its front surface as well as on its rear surface, provided with a set of four marks **31**, every mark **31** comprising a number. In order to enable identification of the puzzle pieces **30**, every puzzle piece **30** is provided with unique numbers, which do not occur on any of the other puzzle pieces **30**.

An advantage of the utilization of numbers is that it is easy to define which side of the mark **31** is to be regarded as the upper side and which side of the mark **31** is to be regarded as the under side, in other words, what the upright position of the numbers is. For most numbers, it is unambiguously clear what their upright position is. In cases in which two possibilities for the upright position of a number exist, for example in the case of the number 66, the upright position of the number may be determined by underlining the number, wherein it is defined that the side at which the line is positioned is to be regarded as the under side of the number.

In this case, as the puzzle pieces **30** are constituted by imaginary squares and the circumference **24** of the recess **23** has a rectangular shape, there are four different ways in which a puzzle piece **30** may be oriented with respect to this circumference **24**, for both its front surface and its rear surface. In order to be able to represent each possible orientation, the four numbers  
5 on both main surfaces of the puzzle piece **30** have different orientations, such that numbers which follow each other when following a circumference of the puzzle piece **30** are rotated a quarter turn with respect to each other.

Further, in cases in which the main surfaces of a puzzle piece **30** have different shapes, so that the shape of the puzzle piece **30** changes when it is flipped over, the different sides of the  
10 puzzle piece **30** are provided with different sets of numbers.

The way in which the puzzle pieces **30** are marked and identified will be explained in more detail in the following description of the separate puzzle pieces **30**.

In **Figures 4-15**, the 12 different puzzle pieces **30** of the puzzle game are shown. For the sake of clarity of the following description of the puzzle pieces **30**, the following arbitrary  
15 definitions are applied:

- the position of the puzzle piece **30** as shown in the figure is the upright position;
- the position of the puzzle piece **30** as shown at the left-hand side of the figure is the position in which the front surface is up, whereas the position of the puzzle piece **30** as shown at the right-hand side of the figure is the position in which the rear surface is up;
- 20 - the imaginary squares of the puzzle pieces **30** are counted from top to bottom and from left to right; and
- in the orientation as shown, the top of the puzzle piece **30** will also be indicated North, the bottom of the puzzle piece **30** will also be indicated South, the left-hand side of the puzzle piece **30** will also be indicated West, and the right-hand side of the puzzle piece **30** will also be  
25 indicated East. The orientation as shown will also be referred to as North-up. The orientations obtained by clockwise rotation over 90°, 180° and 270° will also be referred to as West-up, South-up and East-up, respectively.

**Figure 4** shows a first puzzle piece **1**, which is constituted by a vertical row of four imaginary squares of equal size and one imaginary square which adjoins a right side of a second

square of the row. The shape of a front surface **F** of the first puzzle piece **1** differs from the shape of a rear surface **R** of the first puzzle piece **1**.

There are eight mutually different ways to place the first puzzle piece **1** in a puzzle game solution. In other words, the first puzzle piece **1** has eight different appearances. The concept of “appearance” relates to the number of ways in which a puzzle piece **30** can be fit in a recess having a certain shape. In this example, in which the puzzle pieces **30** are shaped as pentomino pieces, each puzzle piece **30** can have eight different orientations: four with the front main surface up and four with the rear main surface up. In some of the puzzle pieces **30**, two, four or even eight of these orientations can constitute the same appearance, meaning that there are two, four or eight different ways in which the puzzle piece **30** can be fit into the same recess. In other puzzle pieces **30**, each orientation constitutes a different appearance. It will be understood that the number of appearances of a puzzle piece **30** relates to rotation symmetry the puzzle piece **30** may possess.

To identify the eight different appearances of the first puzzle piece **1**, the front surface **F** and the rear surface **R** of the first puzzle piece **1** are provided with different sets of four different marks **31**.

In this case, the front surface **F** is provided with numbers 16, 75, 17 and 41. In the North-up orientation of the first puzzle piece **1**, the number 16 is in an upright position. In the West-up orientation of the first puzzle piece **1**, the number 75 is in an upright position. This will also be indicated as “the number 75 is facing West”. Similarly, the number 17 is facing South and the number 41 is facing East. Further, in this case, the rear surface **R** is provided with numbers 15, 43, 21 and 70, wherein the number 15 is facing North, the number 43 is facing West, the number 21 is facing South and the number 70 is facing East.

**Figure 5** shows a second puzzle piece **2**, which is constituted by a horizontal row of three imaginary squares of equal size, one imaginary square which adjoins a top side of a second square of the row and one imaginary square which adjoins a bottom side of a third square of the row. The shape of a front surface **F** of the second puzzle piece **2** differs from the shape of a rear surface **R** of the second puzzle piece **2**.

There are eight mutually different ways to place the second puzzle piece **2** in a puzzle game solution. To identify these eight different appearances, the front surface **F** and the rear surface **R** of the second puzzle piece **2** are provided with different sets of four different marks **31**.

In this case, the front surface **F** is provided with numbers 40, 32, 37 and 54, wherein the number 40 is facing North, the number 32 is facing West, the number 37 is facing South and the number 54 is facing East. Further, in this case, the rear surface **R** is provided with numbers 42, 67, 46 and 24, wherein the number 42 is facing North, the number 67 is facing West, the number 46 is facing South and the number 24 is facing East.

**Figure 6** shows a third puzzle piece **3**, which is constituted by a vertical row of four imaginary squares of equal size and one imaginary square which adjoins a left side of a fourth square of the row. The shape of a front surface **F** of the third puzzle piece **3** differs from the shape of a rear surface **R** of the third puzzle piece **3**.

There are eight mutually different ways to place the third puzzle piece **3** in a puzzle game solution. To identify these eight different appearances, the front surface **F** and the rear surface **R** of the third puzzle piece **3** are provided with different sets of four different marks **31**.

In this case, the front surface **F** is provided with numbers 18, 35, 52 and 77, wherein the number 18 is facing North, the number 35 is facing West, the number 52 is facing South and the number 77 is facing East. Further, in this case, the rear surface **R** is provided with numbers 19, 58, 66 and 44, wherein the number 19 is facing North, the number 58 is facing West, the number 66 is facing South and the number 44 is facing East.

**Figure 7** shows a fourth puzzle piece **4**, which is constituted by a horizontal row of three imaginary squares of equal size, one imaginary square which adjoins a top side of a first square of the row and one imaginary square which adjoins a bottom side of a third square of the row. The shape of a front surface **F** of the fourth puzzle piece **4** differs from the shape of a rear surface **R** of the fourth puzzle piece **4**. On the other hand, the appearance of the fourth puzzle piece **4** in the North-up orientation equals the appearance of the fourth puzzle piece **4** in the South-up orientation. As a consequence, there are four mutually different ways to place the fourth puzzle piece **4** in a puzzle game solution. To identify these four different appearances, the front surface **F** as well as the rear surface **R** of the fourth puzzle piece **4** is provided with two mutually

different pairs of marks **31**, wherein the pairs of marks **31** on the front surface **F** and the pairs of marks **31** on the rear surface **R** are mutually different as well.

In this case, the front surface **F** is provided with two numbers 36 and two numbers 49, wherein one number 36 is facing North, another number 36 is facing South, one number 49 is facing West and another number 49 is facing East. Further, in this case, the rear surface **R** is provided with two numbers 45 and two numbers 65, wherein one number 45 is facing North, another number 45 is facing South, one number 65 is facing West and another number 65 is facing East.

**Figure 8** shows a fifth puzzle piece **5**, which is constituted by a vertical row of three imaginary squares of equal size and a vertical row of two imaginary squares of equal size, wherein a second square of the row of two squares adjoins a left side of a first square of the row of three squares. The shape of a front surface **F** of the fifth puzzle piece **5** differs from the shape of a rear surface **R** of the fifth puzzle piece **5**.

There are eight mutually different ways to place the fifth puzzle piece **5** in a puzzle game solution. To identify these eight different appearances, the front surface **F** and the rear surface **R** of the fifth puzzle piece **5** are provided with different sets of four different marks **31**.

In this case, the front surface **F** is provided with numbers 39, 55, 23, 57, wherein the number 39 is facing North, the number 55 is facing West, the number 23 is facing South and the number 57 is facing East. Further, in this case, the rear surface **R** is provided with numbers 48, 73, 28 and 69, wherein the number 48 is facing North, the number 73 is facing West, the number 28 is facing South and the number 69 is facing East.

**Figure 9** shows a sixth puzzle piece **6**, which is constituted by a horizontal row of three imaginary squares of equal size, one imaginary square which adjoins a top side of a second square of the row and one imaginary square which adjoins a bottom side of the second square of the row. The shape of a front surface **F** of the sixth puzzle piece **6** equals the shape of a rear surface **R** of the sixth puzzle piece **6**. Further, the appearances of the sixth puzzle piece **6** are the same for the North-up orientation, the West-up orientation, the South-up orientation and the East-up orientation. As a consequence, there is only one way to place the sixth puzzle piece **6** in a puzzle game solution. Therefore, the sixth puzzle game **6** may be identified by only one mark **31**. Although there is no need for using both the front side **F** and the rear side **R** of the sixth



puzzle piece **6** when looking for a solution, for the sake of convenience, it may be preferred to provide both the front side **F** and the rear side **R** of the sixth puzzle piece **6** with a mark **31**. In the shown example, the front surface **F** and the rear surface **R** of the sixth puzzle piece **6** are provided with equal sets of four equal marks **31**, wherein the marks **31** of one set have mutually different orientations. In this case, the marks **31** comprise the number 33.

**Figure 10** shows a seventh puzzle piece **7**, which is constituted by a vertical row of three imaginary squares of equal size, one imaginary square which adjoins a right side of a first square of the row and one imaginary square which adjoins a right side of a second square of the row. The shape of a front surface **F** of the seventh puzzle piece **7** differs from the shape of a rear surface **R** of the seventh puzzle piece **7**.

There are eight mutually different ways to place the seventh puzzle piece **7** in a puzzle game solution. To identify these eight different appearances, the front surface **F** and the rear surface **R** of the seventh puzzle piece **7** are provided with different sets of four different marks **31**.

In this case, the front surface **F** is provided with numbers 53, 72, 29 and 60, wherein the number 53 is facing North, the number 72 is facing West, the number 29 is facing South and the number 60 is facing East. Further, in this case, the rear surface **R** is provided with numbers 63, 61, 25 and 62, wherein the number 63 is facing North, the number 61 is facing West, the number 25 is facing South and the number 62 is facing East.

**Figure 11** shows an eighth puzzle piece **8**, which is constituted by a horizontal row of three imaginary squares of equal size, one imaginary square which adjoins a top side of a third square of the row and one imaginary square which adjoins a bottom side of the third square of the row. The shape of a front surface **F** of the eighth puzzle piece **8** equals the shape of a rear surface **R** of the eighth puzzle piece **8**. As a consequence, there are four mutually different ways to place the eighth puzzle piece **8** in a puzzle game solution. To identify these four different appearances, the front surface **F** as well as the rear surface **R** of the eighth puzzle piece **8** is provided with four mutually different marks **31**, wherein the marks **31** on the front surface **F** and the marks **31** on the rear surface **R** are the same.

In this case, the front surface **F** is provided with numbers 30, 26, 31 and 71, wherein the number 30 is facing North, the number 26 is facing West, the number 31 is facing South and the

number 71 is facing East. Further, in this case, the rear surface **R** is also provided with numbers 30, 26, 31 and 71, wherein the number 31 is facing North, the number 71 is facing West, the number 30 is facing South and the number 26 is facing East.

It will be understood that if the rear surface **R** of the eighth puzzle piece **8** is rotated over 180° with respect to the position in which it is depicted in **Figure 11**, the rear surface **R** equals the front surface **F** in every aspect. Therefore, in placing the eighth puzzle piece **8** in a puzzle game solution, it does not matter which one of the front side **F** and the rear side **R** is placed up.

**Figure 12** shows an ninth puzzle piece **9**, which is constituted by a vertical row of three imaginary squares of equal size, one imaginary square which adjoins a left side of a first square of the row and one imaginary square which adjoins a left side of a third square of the row. The shape of a front surface **F** of the ninth puzzle piece **9** equals the shape of a rear surface **R** of the ninth puzzle piece **9**. As a consequence, there are four mutually different ways to place the ninth puzzle piece **9** in a puzzle game solution. To identify these four different appearances, the front surface **F** as well as the rear surface **R** of the ninth puzzle piece **9** is provided with four mutually different marks **31**, wherein the marks **31** on the front surface **F** and the marks **31** on the rear surface **R** are the same.

In this case, the front surface **F** is provided with numbers 64, 34, 51 and 59, wherein the number 64 is facing North, the number 34 is facing West, the number 51 is facing South and the number 59 is facing East. Further, in this case, the rear surface **R** is also provided with numbers 64, 34, 51 and 59, wherein the number 51 is facing North, the number 59 is facing West, the number 64 is facing South and the number 34 is facing East.

It will be understood that if the rear surface **R** of the ninth puzzle piece **9** is rotated over 180° with respect to the position in which it is depicted in **Figure 12**, the rear surface **R** equals the front surface **F** in every aspect. Therefore, in placing the ninth puzzle piece **9** in a puzzle game solution, it does not matter which one of the front side **F** and the rear side **R** is placed up.

**Figure 13** shows an tenth puzzle piece **10**, which is constituted by two horizontal rows of two imaginary squares of equal size, wherein a top side of a second square of a bottom row adjoins a bottom side of a first square of a top row, and one imaginary square which adjoins a top side of a second square of the top row. The shape of a front surface **F** of the tenth puzzle piece **10** equals the shape of a rear surface **R** of the tenth puzzle piece **10**. As a consequence, there are

four mutually different ways to place the tenth puzzle piece **10** in a puzzle game solution. To identify these four different appearances, the front surface **F** as well as the rear surface **R** of the tenth puzzle piece **10** is provided with four mutually different marks **31**, wherein the marks **31** on the front surface **F** and the marks **31** on the rear surface **R** are the same.

5 In this case, the front surface **F** is provided with numbers 47, 38, 56 and 68, wherein the number 47 is facing North, the number 38 is facing West, the number 56 is facing South and the number 68 is facing East. Further, in this case, the rear surface **R** is also provided with numbers 47, 38, 56 and 68, wherein the number 38 is facing North, the number 56 is facing West, the number 68 is facing South and the number 47 is facing East.

10 It will be understood that if the rear surface **R** of the tenth puzzle piece **10** is rotated over 90° in an anti-clockwise direction with respect to the position in which it is depicted in **Figure 13**, the rear surface **R** equals the front surface **F** in every aspect. Therefore, in placing the tenth puzzle piece **10** in a puzzle game solution, it does not matter which one of the front side **F** and the rear side **R** is placed up.

15 **Figure 14** shows an eleventh puzzle piece **11**, which is constituted by a horizontal row of three imaginary squares of equal size and a vertical row of two imaginary squares of equal size, wherein a second square of the vertical row adjoins a top side of a third square of the horizontal row. The shape of a front surface **F** of the eleventh puzzle piece **11** equals the shape of a rear surface **R** of the eleventh puzzle piece **11**. As a consequence, there are four mutually different  
20 ways to place the eleventh puzzle piece **11** in a puzzle game solution. To identify these four different appearances, the front surface **F** as well as the rear surface **R** of the eleventh puzzle piece **11** is provided with four mutually different marks **31**, wherein the marks **31** on the front surface **F** and the marks **31** on the rear surface **R** are the same.

25 In this case, the front surface **F** is provided with numbers 27, 22, 50 and 74, wherein the number 27 is facing North, the number 22 is facing West, the number 50 is facing South and the number 74 is facing East. Further, in this case, the rear surface **R** is also provided with numbers 27, 22, 50 and 74, wherein the number 22 is facing North, the number 50 is facing West, the number 74 is facing South and the number 27 is facing East.

30 It will be understood that if the rear surface **R** of the eleventh puzzle piece **11** is rotated over 90° in an anti-clockwise direction with respect to the position in which it is depicted in

**Figure 14**, the rear surface **R** equals the front surface **F** in every aspect. Therefore, in placing the eleventh puzzle piece **11** in a puzzle game solution, it does not matter which one of the front side **F** and the rear side **R** is placed up.

**Figure 15** shows a twelfth puzzle piece **12**, which is constituted by a horizontal row of five imaginary squares of equal size. The shape of a front surface **F** of the twelfth puzzle piece **12** equals the shape of a rear surface **R** of the twelfth puzzle piece **12**. Therefore, in placing the twelfth puzzle piece **12** in a puzzle game solution, it does not matter which one of the front side **F** and the rear side **R** is placed up. Further, the appearance of the twelfth puzzle piece **12** in the North-up orientation equals the appearance of the twelfth puzzle piece **12** in the South-up orientation, and the appearance of the twelfth puzzle piece **12** in the West-up orientation equals the appearance of the twelfth puzzle piece **12** in the East-up orientation. As a consequence, there are two mutually different ways to place the twelfth puzzle piece **12** in a puzzle game solution. To identify these two different appearances, the front surface **F** as well as the rear surface **R** of the twelfth puzzle piece **12** is provided with two mutually different pairs of marks **31**, wherein the pairs of marks **31** on the front surface **F** and the pairs of marks **31** on the rear surface **R** are the same. **Figure 15** clearly shows that the shape of the twelfth puzzle piece **12** and the marks **31** are the same for the front surface **F** and the rear surface **R**.

In this case, the front surface **F** as well as the rear surface **R** is provided with two numbers 76 and two numbers 20, wherein one number 76 is facing North, another number 76 is facing South, one number 20 is facing West and another number 20 is facing East.

An example of a configuration of the puzzle pieces **30** in the recess **23** of the holder **20** is shown in **Figure 3**. The various numbers on the puzzle pieces **30** offer the possibility of recording this configuration. This may be done by writing down the numbers which are in an upright position, following an imaginary route from left to right and from top to bottom of the recess **23**. When it is assumed that in the upright position of **Figure 3** the upright position of the recess **23** is shown, the configuration of the puzzle pieces **30** is laid down in the following code:

16 - 64 - 18 - 53 - 47 - 33 - 30 - 20 - 40 - 39 - 22 - 36.

There are other possibilities for the sequence in which the numbers may be read, for example from top to bottom and from left to right of the recess **23**. However, the possibility of

going from left to right and from top to bottom is preferred, as this resembles the reading of a book.

Preferably, the numbers are positioned on the main surface of the puzzle piece **30** such that each number is closest to the edge which constitutes the top edge when the puzzle piece **30** is in an orientation which corresponds to the orientation of the number.

It is noted that, if the completed puzzle as shown in **Figure 3** is rotated, a different coding for the solution appears. The definition of the upper side and the under side of the recess **23** determines which coding is used for a certain solution, as this definition determines which numbers are recorded and the sequence in which the numbers are recorded.

In the example as shown, the recess **23** is mirror symmetrical. Therefore, if the holder **20** is rotated over  $180^\circ$ , another solution can easily be found, without the need of changing the positions of the puzzle pieces **30**, whereas in fact the completed puzzle is rotated  $180^\circ$  with respect to the recess **23**.

The codes are not only helpful in finding all possible configurations of the puzzle pieces **30** in the recess **23** of the holder **20**; they also constitute a helpful communication means in case two or more players wish to provide each other with solutions or to compare their solutions.

The minimum number of different marks **31** which is needed to ensure identification of the orientation of the puzzle pieces **30**, may be determined by performing the following steps:

- Determine the number of possible orientations of the puzzle piece **30** with respect to the border. In the shown example, this number is eight.

- Determine in how many different ways the puzzle piece **30** is rotation symmetrical. In the example of the fourth puzzle piece **4**, the number of different ways is two, as the fourth puzzle piece **4** is one time rotation symmetrical at the front surface **F** as well as at the rear surface **R**. In the example of the twelfth puzzle piece **12**, the number of different ways is four, as the twelfth puzzle piece **12** is two times rotation symmetrical at the front surface **F** as well as at the rear surface **R**. In the example of the sixth puzzle piece **6**, the number of different ways is eight, as the sixth puzzle piece **6** is four times rotation symmetrical at the front surface **F** as well as at the rear surface **R**.

- Divide the number of possible orientations by the number of different ways in which the puzzle piece **30** is rotation symmetrical. The resulting number indicates the number of

appearances of the puzzle piece **30**, and is the minimum number of different marks **31** which is needed to ensure identification of the orientation of the puzzle piece **30**. In the example of the fourth puzzle piece **4**, the resulting number is four, in the example of the twelfth puzzle piece **12**, the resulting number is two, and in the example of the sixth puzzle piece **6**, the resulting number is one.

All shown puzzle pieces **30** are provided with eight marks **31**. The number of times that each mark **31** appears on the puzzle piece equals the number of different ways in which the puzzle piece **30** is rotation symmetrical.

As already mentioned in the foregoing, 9,356 possible different configurations of the puzzle pieces **30** exist. A player may try to find all these configurations in a systematic manner, by using a certain puzzle piece **30** in a certain orientation in a left upper corner of the recess **23** as a starting point, and looking for all possible solutions which can be found when starting from this starting point before choosing a new starting point. In the following table, a review is given of all possible starting points and the associated number of all possible solutions. Every starting point is denoted as a number, which corresponds to the number which at that starting point constitutes the first number of the code of the solution.

starting point	number of solutions		starting point	number of solutions		starting point	number of solutions
16	288		39	118		67	62
19	153		50	1,092		68	126
20	618		51	561		69	131
21	179		52	507		70	181
22	72		53	332		71	501
23	159		58	333		72	89
25	110		59	481		73	148
31	551		60	63		74	108
35	28		62	342		75	72
36	223		63	120		76	838
37	136		65	237		77	159

38	204		66	34		TOTAL	9,356
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In a suitable embodiment of the puzzle pieces **30**, the sides of the imaginary squares of which the puzzle pieces **30** are constituted, are 15.0 mm long. Further, in an advantageous embodiment, the thickness of the puzzle pieces **30** equals the depth of the recess **23** of the holder **20** by being 4.0 mm.

Preferably, the puzzle pieces **30** are made of a plastic. The puzzle pieces **30** may be manufactured by means of injection moulding, wherein the marks **31** may be formed as recesses with respect to the main surface of the puzzle pieces **30** during the injection moulding process. There are other ways of providing the puzzle pieces **30** with marks **31** formed as recesses with respect to the main surface of the puzzle pieces **30**, for example by means of milling or laser-beam techniques.

The marks **31** may also be applied by means of stickers on which the marks **31** are printed, wherein the sticker preferably is suitable to cover an entire main surface of a puzzle piece **30**. In case of a front surface **F** of a puzzle piece **30** having the same shape as a rear surface **R** of the puzzle piece **30**, it is sufficient to cover only one main surface with a sticker. All stickers of different puzzle pieces **30** may have the same color, but it is for example also possible to have stickers with different colors for different puzzle pieces **30**, or to assign one color to stickers which are intended to cover the front surfaces **F** of the puzzle pieces **30** and another color to stickers which are intended to cover the rear surfaces **R** of the puzzle pieces **30**.

In order to facilitate storing and transporting of the holder **20** and the puzzle pieces **30**, the puzzle game may comprise a sleeve (not shown) which is suitable to fit tightly around the holder **20**, in order to prevent falling out of the puzzle pieces **30**. Such a sleeve may be made of cardboard or another suitable material.

It will be clear to a person skilled in the art that the scope of the present invention is not limited to the examples discussed in the foregoing, but that several amendments and modifications thereof are possible without deviating from the scope of the invention as defined in the attached claims.

The numbers on the puzzle pieces **30** as described in the foregoing, are arbitrarily chosen and may be replaced by other numbers.

In the foregoing, marks **31** comprising numbers are shown. It will be understood that there are other possibilities, wherein it is important that the orientation of the marks **31** may readily be determined. The marks **31** may for example comprise combinations of two small letters of the alphabet, or even constitute words, such that each solution constitutes a sentence.

5 Also, the marks **31** may comprise pictures of animals or other recognizable pictures.

**Figure 16** shows an example of symbols used as marks. Each symbol has an upright orientation, which is defined by an arrow.

It is not an essential feature of the present invention that all puzzle pieces **30** of the puzzle game are provided with the same type of marks **31**. It is even possible to provide one puzzle  
10 piece **30** with marks **31** of different types. In the puzzle game, for the sake of identification the puzzle pieces **30**, it is important that marks **31** which occur on a certain puzzle piece **30** do not occur on other puzzle pieces **30** having a different shape. Further, for the sake of determination of the orientation of a puzzle piece **30**, it is important that the puzzle piece is provided with different marks **31** in different orientations, for each of the possible orientations of the puzzle  
15 piece **30**.

Preferably, a puzzle piece **30** comprises identical marks **31** for identical appearances of the puzzle piece **30**.

In a symmetrical puzzle piece **30**, the number of marks **31** may be reduced. For example, the sixth puzzle piece **6** as shown in **Figure 9** may be provided with only one mark **31**. This one  
20 mark **31** may for example be positioned in the centre of the front surface **F**, and may comprise a symbol having the same symmetry as the sixth puzzle piece **6**, for example a square or a circle.

It will be understood that within the scope of the invention, the number of puzzle pieces may be chosen to be different than 12, for example 18, the puzzle pieces do not need to be pentomino pieces, and the shape of the circumference of a completed puzzle may chosen to be  
25 different than rectangular.